REMARKS

The Final Office Action mailed June 8, 2005, has been received and reviewed. Claims 1 through 6, 8 and 9 are currently pending in the application. Claims 1 through 6, 8 and 9 stand rejected. Applicant has canceled claims 1-6, 8 and 9 and has added new claims 10-31. This Amendment is filed with a Request for Continued Examination. Reconsideration is respectfully requested.

35 U.S.C. § 103(a) Obviousness Rejections

Obviousness Rejection Based on U.S. Patent No. 5,883,001 to Jin et al. in view of U.S. Patent No. 4,943,539 to Wilson et al.

Claims 1 through 6, 8 and 9 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Jin et al. (U.S. Patent No. 5,883,001) in view of Wilson et al. (U.S. Patent No. 4,943,539). Claims 1 through 6, 8 and 9 have been canceled. Thus, the rejection of these claims is moot. Applicant respectfully submits new claims 10-31 are not rendered obvious by the proposed combination of art.

> M.P.E.P. 706.02(j) sets forth the standard for a Section 103(a) rejection:
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> To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, **the prior art reference (or references when combined) must teach or suggest all the claim limitations.** The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). (Emphasis added).

Jin discloses a two-step etching process for making a multilayer metallization structure. A metal contact 23 is formed over a region 19. A dielectric barrier 24 of SiON or silicon nitride is formed over the metal contact 23. Then, a flowable glass dielectric layer 25 is deposited over which another dielectric layer 27 is formed. A PSG layer 28 is formed on the dielectric layer 27 and a photoresist layer 30 is formed over the PSG layer 28.

To create an opening to the metal contact 23, the photoresist is patterned and an opening 26 is etched which exposes the PSG layer 28. (Jin, Figs. 4 and 5.) An isotropic etch is performed through the PSG layer 28 and part of the dielectric layer 27 using 10:1 BOE. (Jin, Fig. 6, col. 7, lines 31-35.) *The isotropic etch creates tapered sidewalls 35, 36 on the opening 26.* (Jin, col. 6, lines 37-39) (emphasis added). Jin next discloses an anisotropic etch through the dielectric layer 27, glass dielectric layer 25 and barrier dielectric layer 24 to expose the metal contact 23. The anisotropic etch consists of a main etch and an overetch to remove oxide residue from the metal contact 23, but which may induce charging damage to the device. (Jin, col. 7, lines 51-55.) A wet etch is used to minimize damage, but create tapered sidewalls. (Jin, col. 6, lines 58-62 and lines 37-39.)

Wilson discloses a two-step *etching* process for making a multilayer metallization structure. A first interconnect layer 12 is formed on a dielectric layer 11. The first interconnect layer 12 is covered by a first metal layer 13 which is then covered by a sacrificial layer 14. (Wilson, col. 3, lines 49-51). Preferably, the first interconnect layer comprises aluminum copper alloy, the first metal layer 13 comprises TiW or TiSi and sacrificial layer 14 comprises aluminum alloy or titanium nitride. (Id., col. 3, lines 53-57; col. 4, lines 4-5.) The layers 12, 13, 14 are patterned and an interlayer dielectric 16 is formed thereover. (Wilson, FIG. 2.) The dielectric layer 16 is patterned and dry etched to expose the sacrificial layer 14. (Id. col. 4, lines 17-24; FIG. 3.) A second isotropic etch, preferably comprising a *solution* of nitric acid, phosphoric acid, and acetic acid, is then performed. (Id. col. 4, lines 34-38.) The isotropic etch removes residual backsputtered material 19 and etches sacrificial layer 14 in both a downward and sideways direction to create a single "T" shaped void. (Cf. Wilson, FIGs. 3 and 4.)

Applicant respectfully submits that the combination of Jin and Wilson fails to teach or suggest every element of the presently claimed invention. Independent claim 10 recites a "method of removing oxide polymer and metal polymer from a contact opening in a dielectric layer on a semiconductor substrate, the method comprising performing a nitric acid solution dip followed by a phosphoric acid solution dip." Jin lacks any disclosure of nitric acid solution dip followed by a phosphoric acid solution dip. Instead, Jin discloses removing *oxide* residues from

the metal contact 23 by an overetch and lacks any disclosure of removing *metal* residue from the opening 26. (Jin, col. 7, lines 50-55). Wilson also fails to teach or suggest "a nitric acid solution dip followed by a phosphoric acid solution dip." Instead, Wilson merely teaches forming a via by a wet chemical etch of nitric acid, phosphoric acid **and** acetic acid. (Wilson, col. 4, lines 34-38).

Wilson merely discloses a nitric acid/ phosphoric acid *etching solution* simultaneously to create an opening but does not teach or suggest a subsequent application of any acid. (Wilson, FIGS. 3-4, 6; col. 4, lines 35-55, col. 5, lines 20-30). As the combination of Jin and Wilson fails to teach or suggest every element of the presently claimed invention, applicant respectfully submits that claim 10 is not rendered obvious by the cited art. Accordingly, claim 10 of the presently claimed invention is allowable.

Claims 11-20 are each allowable as depending, either directly or indirectly, from allowable claim 10.

Claim 11 is further allowable as the combination of art fails to teach or suggest performing the nitric acid solution dip at a concentration of between about 50% and 100% by weight.

Claim 12 is further allowable as the combination of art fails to teach or suggest applying the nitric acid solution dip for a time span of between about 10 seconds and 30 minutes.

Claim 13 is further allowable as the combination of art fails to teach or suggest applying the nitric acid solution dip in a time span of about 200 seconds.

Claim 14 is further allowable as the combination of art fails to teach or suggest applying the nitric acid solution dip at a temperature of between about 10°C and 80°C.

Claim 15 is further allowable as the combination of art fails to teach or suggest performing the phosphoric acid solution dip at a concentration of between about 200 volumes of water to about 1 volume of phosphoric acid and about 1 volume of water to about 1 volume of phosphoric acid.

Claim 16 is further allowable as the combination of art fails to teach or suggest applying the phosphoric acid solution dip at a temperature of between about 10°C and 80°C.

Claim 17 is further allowable as the combination of art fails to teach or suggest applying the phosphoric acid solution dip for a time span of between about 10 seconds and 10 minutes.

Claim 18 is further allowable as the combination of art fails to teach or suggest that the phosphoric acid solution dip further includes a fluorine-containing component.

Claim 19 is further allowable as the combination of art fails to teach or suggest that the fluorine-containing component includes hydrofluoric acid.

Claim 20 is further allowable as the combination of art fails to teach or suggest that the fluorine-containing component includes ammonium fluoride.

Independent claim 21 of the presently claimed invention recites a "method of fabricating a via in a dielectric layer and an underlying barrier layer for a semiconductor device, comprising: forming a partial via in the dielectric layer to expose at least portion of the barrier layer; cleaning the partial via with a phosphoric acid-containing solution; etching the barrier layer after the cleaning to form a full via having a metal containing trace on a bottom surface thereof; and applying a nitric-acid containing solution to the full via." Applicant respectfully submits that the proposed combination of Jin and Wilson fails to teach or suggest every limitation of claim 21 of the presently claimed invention.

Jin fails to teach or suggest "cleaning the partial via with a phosphoric acid-containing solution" or "applying a nitric-acid containing solution to the full via." Instead, Jin discloses removing *oxide* residues from the metal contact 23 by an overetch and lacks any disclosure of removing *metal* residue from the opening 26. (Jin, col. 7, lines 50-55). Wilson fails to teach or suggest "cleaning the partial via with a phosphoric acid-containing solution; etching the barrier layer after the cleaning to form a full via having a metal containing trace on a bottom surface thereof; and applying a nitric-acid containing solution to the full via." Instead, Wilson merely teaches *forming* a via by a wet chemical etch of nitric acid, phosphoric acid **and** acetic acid. (Wilson, col. 4, lines 34-38). Wilson merely discloses a nitric acid/ phosphoric acid *etching solution* simultaneously to create an opening but does not teach or suggest a subsequent application of any acid. (Wilson, FIGS. 3-4, 6; col. 4, lines 35-55, col. 5, lines 20-30). As the combination of Jin and Wilson fails to teach or suggest every element of the presently claimed

invention, applicant respectfully submits that claim 10 is not rendered obvious by the cited art. Accordingly, claim 21 of the presently claimed invention is allowable.

Claims 22-31 are each allowable as depending, either directly or indirectly, from allowable claim 10.

Claim 22 is further allowable as the proposed combination fails to teach or suggest applying the nitric acid-containing solution at a concentration of between about 50% and 100% by weight.

Claim 23 is further allowable as the proposed combination fails to teach or suggest applying the nitric acid-containing solution for a time span of between about 10 seconds and 30 minutes.

Claim 24 is further allowable as the proposed combination fails to teach or suggest applying the nitric acid-containing solution in a time span of about 200 seconds.

Claim 25 is further allowable as the proposed combination fails to teach or suggest applying the nitric acid -containing solution at a temperature of between about 10°C and 80°C.

Claim 26 is further allowable as the proposed combination fails to teach or suggest cleaning the partial via with the phosphoric acid -containing solution at a concentration of between about 200 volumes of water to about 1 volume of phosphoric acid and about 1 volume of water to about 1 volume of phosphoric acid.

Claim 27 is further allowable as the proposed combination fails to teach or suggest cleaning the partial via with the phosphoric acid-containing solution at a temperature of between about 10°C and 80°C.

Claim 28 is further allowable as the proposed combination fails to teach or suggest cleaning the partial via with the phosphoric acid -containing solution for a time span of between about 10 seconds and 10 minutes.

Claim 29 is further allowable as the proposed combination fails to teach or suggest the phosphoric acid -containing solution further includes a fluorine-containing component.

Claim 30 is further allowable as the proposed combination fails to teach or suggest the fluorine-containing component includes hydrofluoric acid.

Claim 31 is further allowable as the proposed combination fails to teach or suggest the fluorine-containing component includes ammonium fluoride.

ENTRY OF AMENDMENTS

The new claims above should be entered by the Examiner because the amendments are supported by the as-filed specification and drawings and do not add any new matter to the application.

CONCLUSION

Claims 10-31 are believed to be in condition for allowance, and an early notice thereof is respectfully solicited. Should the Office determine that additional issues remain which might be resolved by a telephone conference, the Examiner is respectfully invited to contact Applicant's undersigned attorney.

Respectfully submitted,

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